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How loss averse are investors in financial markets?

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ABSTRACT

We investigate loss aversion in financial markets using a typical asset allocation problem. Our theoretical and empirical results show that investors in financial markets are more loss averse than assumed in the literature. Moreover, loss aversion changes depending on market conditions; investors become far more loss averse during bull markets than during bear markets, indicating their more profound disutility for losses when others enjoy gains. Contrary to most previous results, we find that investors are more sensitive to changes in losses than changes in gains.

1. Introduction

According to prospect theory, proposed by Kahneman and Tversky (1979), individuals maximize a weighted sum of a 'value' function. Decisions are made in terms of gains or losses rather than final wealth, and the 'value' of a loss is compensated for by two to three times the 'value' of a gain equivalent to that loss; hence, the notion of loss aversion. Loss aversion 'power' utility is a functional form of prospect theory devised by Kahneman and Tversky (1992); this utilizes power utility and is designed to satisfy the properties of prospect theory. Unlike power utility that involves one parameter, the loss aversion 'power' utility (henceforth LA utility) involves three parameters: two curvature parameters explain the sensitivity of utility to losses and gains, and a coefficient of loss aversion measures the relative disutility of losses against gains.

Understanding these parameters is essential in the same way as the risk aversion coefficient of power utility is crucial in expected utility theory.[1] Kahneman and Tversky (1992) suggest a set of parameter values for LA utility using experiments. Benartzi and Thaler (1995), Barberis et al. (2001), Ang et al. (2005), and Barberis and Xiong (2009) use similar values in their studies. Other studies such as Wu and Gonzalez (1996) estimate that the values of the two curvature parameters are identical but significantly smaller than those of Kahneman and Tversky (1992). However, Burnes and Neilson (2002) show that these values cannot simultaneously explain gambles on unlike gains and the Allais paradox. In general, decision makers are loss averse and there is more utility curvature for gains than for losses. See Abdellaoui et al. (2007) and Wakker et al. (2007) for further discussion of the shape of LA utility.

Despite the importance of loss aversion, the robustness and appropriateness of loss aversion utility function in financial markets have not been addressed. Although considerable field data has been accumulated since Kahneman and Tversky (1979), the majority of the studies have been conducted in laboratory experiments with students in the fields of decision theory or psychology. Differences may exist in the way these decision makers behave in experiments and in real financial markets (Levitt and List, 2007), because it is difficult to design experiments that include other important components in practice, such as the probability density function of asset returns or decision making with a large dollar amount of investment in financial markets.

In our study, we attempt to determine the appropriate ranges of LA parameters in financial markets using a typical asset allocation problem for investors with LA utility.[2] By analyzing asset allocation

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[1] For instance, for the coefficient of the CRRA, many studies have theoretically suggested that the admissible range lies between one and two. However, debate regarding the appropriate ranges of the CRRA coefficient is far from over. Mehra and Prescott (1985) suggest that the equity premium puzzle can be solved when the coefficient is of the order of 30.

[2] Our approach is a partial equilibrium portfolio choice problem. Unlike an expected utility framework, we do not estimate a reasonable range of parameter values of LA utility function through a set of equilibrium relations (through Euler conditions) linking expected asset returns to covariances with consumption growth. Our study is different from that of Berkelaar and Kouwenberg (2009) who investigate the effects of loss aversion on asset prices.

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decisions of investors who maximize their LA utility, we propose several theoretical results for the LA utility function and the optimal asset allocation, and then show that these analytical results are empirically supported in the US and UK markets. Our main results can be summarized as follows. First, we find that investors are more loss averse than Kahneman and Tversky (1992) suggest; the loss aversion coefficient of 2.25 that has been widely used in the finance literature is lower than what we calculate, in particular, in the US market. This may be interpreted that when investors choose risky prospects that involve large amounts, they become more loss averse than the subjects (students) in laboratory experiments who are asked to choose risky prospects that are smaller in dollar amount or who are asked to choose risky prospects of large amounts in hypothetical situations. Second, loss aversion changes depending on market conditions. In particular, we find that the loss aversion coefficient should be larger during boom periods (bull markets) than during recessions (bear markets), indicating investors' more profound disutility for losses when other investors enjoy their gains. The time variation of loss aversion adds a new dimension to the loss aversion literature, which is already hindered by many different versions of loss aversion (see, for example, Abdellaoui et al., 2007). Third, the curvature on losses should be larger than that of gains, and thus investors are more sensitive to the changes in losses than to the equivalent changes in gains. More utility curvature for losses than for gains is surprising because mostly the opposite is found; see Note 1, Wakker et al. (2007) for a survey. Finally, when UK and US investors are compared, the equity proportion in the typical US pension funds is lower than that in similar UK funds. If we make the simplistic assumption that the loss aversion coefficient is the sole source of the different equity proportions in pension funds, the lower investment proportion in the US pension funds could be interpreted that US investors have a larger loss aversion coefficient than UK investors. However, this does not necessarily suggest that US investors are more loss averse than UK investors, as the loss aversion coefficient could be affected by the differences other than loss aversion, e.g., difference in asset distributions, social/economic welfare, or characters of pension funds.

What parameter values should be used for the LA utility in financial markets? We propose loss aversion coefficients of 3.25 and 2.75 for the US and UK investors, respectively, which should be increased and reduced by 1.5 during bull and bear markets, respectively; and the difference between the two curvature parameters should be 0.2 and 0.25 for the US and UK markets, respectively. Therefore, for investors who are risk averse for gains and risk loving for losses, we suggest that the curvature parameters of the UK investors should be 0.7 and 0.95 for gains and losses, respectively, while those of the US investors should be 0.7 and 0.9 for gains and losses, respectively.

This paper is structured as follows: in Section 2, we present the details of the LA utility and our principal analytic results. In Section 3, we use UK and US asset allocation problems to empirically evaluate the values of LA parameters. Conclusions are provided in Section 4.

2. Admissible analytical ranges of the LA parameters

2.1. Loss aversion utility

Several different definitions of loss aversion have been proposed in the literature; for instance, see Abdellaoui et al. (2007). In an effort to investigate the properties of the function, we use the standard LA function proposed by Kahneman and Tversky (1992) (henceforth KT) with minor modifications. Let W and B represent final wealth and some appropriate benchmark, respectively. The LA utility in our study is defined as

$$u(X) = \begin{cases} \frac{X^{\upsilon_1}}{\upsilon_1}, & \text{if } X \geq 0, \\ -\lambda\frac{(-X)^{\upsilon_2}}{\upsilon_2}, & \text{if } X < 0, \end{cases} \tag{1}$$

where $X = W - B$ determines gains or losses, and the three parameters (i.e., υ_1, υ_2, and λ) are assumed to be positive. As X^{υ_1} and $(-X)^{\upsilon_2}$ are divided by υ_1 and υ_2, respectively, the value of λ is not directly comparable with that of KT, whereas the two curvature parameters, υ_1 and υ_2, are not influenced by the modification. To observe this, when Eq. (1) is multiplied by υ_1, we have the LA function of KT:

$$u(X)^{\text{KT}} = \begin{cases} X^{\upsilon_1}, & \text{if } X \geq 0, \\ -\lambda^{\text{KT}}(-X)^{\upsilon_2}, & \text{if } X < 0, \end{cases} \tag{2}$$

where $\lambda^{\text{KT}} = \lambda\frac{\upsilon_1}{\upsilon_2}$. Therefore, depending on the values of υ_1 and υ_2, λ is larger or smaller than λ^{KT}, and when $\upsilon_1 = \upsilon_2$, our LA utility function is the same as the original LA function of KT.

The properties of LA utility are dependent on the selection of different parameter values, but there appear to be few theoretical results that suggest appropriate values for υ_1, υ_2, and λ.[3] Previous choices for these values are generally based on surveys or experiments such as those reported in the studies of Fishburn and Kochenberger (1979) and KT. When $\upsilon_1 > 1$ and $\upsilon_2 > 1$, the investor is risk loving with regard to gains since $u''(X) = (\upsilon_1 - 1)X^{\upsilon_1 - 2} > 0$, while she is risk averse with regard to losses since $u''(X) = -(\upsilon_2 - 1)(-X)^{\upsilon_2 - 2} < 0$. This is similar to the reversed S-shape utility function of Markowitz (1952) and Post et al. (2008). Other two cases are also possible, i.e., 'risk loving for gains and losses' and 'risk averse for gains and losses'. Balzer (2001) assumes that both the upside and downside are concave, such that the investor is risk averse in both directions. A common assumption regarding investors' behavior in academic studies is the case that $u(\cdot)$ is 'risk averse' with regard to gains but 'risk loving' with regard to losses, which is what Kahneman and Tversky (1979) determine with a series of experiments. KT propose that $\upsilon_1 = \upsilon_2 = 0.88$ and $\lambda = 2.25$, and Burnes and Neilson (2002), Barberis et al. (2001), and Ang et al. (2005) have followed these suggested values.[4] Which of these alternatives is the more plausible is not apparent. One simple method to avoid this parameter choice problem is to assume $\upsilon_1 = \upsilon_2 = 1$, such that $u(\cdot)$ would be risk neutral with regard to gains or losses, which has been used academically and commercially, see Benartzi and Thaler (1995). Several risk-control strategies, prevalent in the market, capture certain aspects of these alternative cases. For example, a stop-loss strategy controls downside risk and is presumably consistent with $\upsilon_2 > 1$. A take-profit strategy controls upside risk and may be consistent with $\upsilon_1 < 1$.

In this study, we focus on the case that $u(\cdot)$ is risk averse with regard to gains but risk loving with regard to losses, following Kahneman and Tversky (1979, 1992). Using a parameter-free method, Abdellaoui et al. (2007) show strong evidence that supports prospect theory; decision makers are loss averse to various definitions, risk averse with respect to gains, and risk loving with respect to losses both at the aggregate and at the individual level.

[3] In the loss aversion utility function in Eqs. (1) or (2), it is possible that marginal utility declines as wealth approaches zero. For the case when W is less than B, and W approaches zero (i.e., $X < 0$), the sign of the second derivative of the utility function would be positive if $\upsilon_2 < 1$, and negative if $\upsilon_2 > 1$. Thus, the utility function can be consistent with microeconomic theory (loss aversion) but also allows for possible loss tolerance.

[4] Fishburn and Kochenberger (1979) put forward two-piece utility functions as an example of conventional expected utility theory, and present some survey evidence suggesting that $\lambda > 1$ and that $0 < \upsilon_1 < 1$ and $0 < \upsilon_2 < 1$. They also refer to other papers that present experimental survey studies supporting these assumptions, namely that investors are risk averse for gains and risk loving for losses.